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Metadata driven data utilization in ecommerce solution

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Insinöörityön tarkoituksena oli kehittää konseptin toteutettavuuden osoitus verkkokaupan sivustosta, joka käyttää hakuhakemistoa tietojen lähteenä. Työssä keskityttiin arvioimaan piirteitä, jotka on todettu tärkeiksi elektronisen kaupankäynnin verkkosovelluksissa. Toteutuksessa arvioitiin sovellusalustan ominaisuuksia ja soveltuvuutta. Työ tehtiin ICT-alan Suomessa toimivalle yritykselle.

Työn tuloksena syntyi verkkokauppa, joka käyttää valitun sovellusalustan ominaisuuksia täyttämään yleiset verkkokauppojen ominaisuudet mahdollisissa määrin. Sovellus käyttää hakuhakemistoa asiakassivuston tietolähteenä, ja tuotetietojen ylläpidolle on erillinen sivusto.

Insinöörityö vaati verkkosovelluksen arkkitehtuurin ja metatietomallin tutkimusta ja niiden soveltamista hakupalveluun. Sovellusalustan hakupalvelun toiminta on yleisluontoista, mutta sitä hyödyntävät komponentit tukeutuvat vahvasti sovellusalustaan.

Insinöörityössä käytetyn sovellusalustan todettiin sisältävän metatietoa hyödyntävää hakutoiminnallisuutta. Sähköisessä kaupankäynnissä tarvittavien ominaisuuksien olemassaolo todettiin, mutta ominaisuudet huomattiin puutteellisiksi laajempaa käyttöä varten. Hakuhakemisto ei sisällä tarpeeksi tietoa kohdennettuun tuotteiden mainostamiseen. Myös ostoskorin puuttuminen havaittiin. Projektissa käytettyjä hakutoiminnallisuuksia voidaan hyödyntää myös muiden sisältötyyppien kohdalla.

Avainsanat	SharePoint, metatieto, haku

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The purpose of this Bachelor's thesis was to develop a proof of concept with SharePoint for ecommerce site that uses search index to provide data. The study concentrated in evaluating features that are seen important in online commerce web sites and how their implementations would suffice in the application platform, which has seen little use in online commerce.

As a result an ecommerce site that utilizes SharePoint 2013 features to fulfill common ecommerce site requirements as well as possible was created. The site uses search index as data provider for the customer site and it has a separate site for product administration that is indexed.

The project required architectural research and understanding of metadata and its use in search services for creating queries and faceted navigation.

The project application platform was found to include many metadata enhanced search functionalities. Ecommerce features were found existing and working but lacking for extensive use. As products are queried from search index there are insufficient information about user preferences or behavior for personalized product promotions. Missing shopping cart functionality was also noted. Search functions described in this project can be used to develop search-driven content utilization also with other content types.

Keywords	SharePoint, ecommerce, metadata

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Terms and abbreviations

AJAX	Asynchronous JavaScript and Extensible Markup Language.
API	Application programming interface.
CMS	Content management system.
CRM	Customer relationship manager.
Faceted navigation	Also known as faceted search, faceted browsing. Enables information filtering with metadata values.
HTML	Hypertext Markup Language.
ICT	Information and communications technology.
PDF	Portable document format.
SharePoint	Microsoft content and document management solution platform.
SharePoint Site Collection	A collection of SharePoint sites within web application.
SharePoint Web Application	A SharePoint container that has singular address in the IIS. Can be considered as the web site that holds every site collection and content.
Web part	Components that can be added into a SharePoint page. Usually they display content for example documents or list views.

1 Introduction

The goal for this thesis was to build a proof of concept for ecommerce site using a SharePoint 2013 product catalog. This thesis covers some of the most important ecommerce site features. Evaluation is done comparing a live ecommerce site with the thesis project site. The thesis deals with project implementation and how features could be implemented in the solution platform. This thesis looks into how some of the most important ecommerce site features have been implemented and compares them to the proof of concept. Features that are not possible or would require excessive customization in the proof of concept are also discussed.

The thesis was done for Digital Illustrated Finland Inc. which builds ICT solutions with Microsoft technologies for companies in Finland. The main know-how in DI is in developing SharePoint solutions but they have also broad know-how on other Microsoft products. The two main goals for the project is to research ecommerce functionalities and to evaluate the product catalog site collection template.

This study aims at clarifying the basic metadata structures and types and how controlled vocabularies are organized in SharePoint. Search services and especially enterprise search and supporting metadata structures are important in information availability. Content sharing between the product catalog and the publishing portal is search-based and will be explained. The thesis explains the architecture for the project environment where product catalog information is queried from different site through search index. The main evaluation focus points are in the out-of-the-box SharePoint 2013 features. From these two features the most important are content search functionalities and metadata service.

2 Metadata

2.1 What is metadata and metadata types

Metadata is information about data and it defines properties of the data. Metadata helps the data to be more understandable to both computers and humans. Data in tables, documents or files can have descriptive metadata that helps filtering by for example the size of the document or title. Every property in documents can be understood as metadata. In data tables with each row representing document or single item, every column could be defined as a metadata property. Metadata can also describe data structures. Metadata is divided in three categories: structural-, administrative- and descriptive metadata. [1]

Structural metadata describes structures between digital compound objects. It tells how parts in an object are formed in relation to other parts. Fusing parts together with this structural definition creates an understandable entity. A common function of a structural navigation is to define the presentation of diverse objects like images or image streams. It also describes how different streams like audio- and image streams can be combined into a single stream. The majority of structural metadata is used in file types and databases. This metadata type makes it possible to store objects in repository and after retrieving to build them back into initial form. [2; 3; 4]

Descriptive metadata is information that helps in the discovery and identification of digital resources. This information describes the resource contents with values like title, description and author that can be used to search a resource from a group of resources. Descriptive metadata can also show how multiple resources are in relation between each other with hierarchical structures or physical attributes. Hierarchical structures are often controlled vocabularies and they will be addressed later. [5, pp. 1-2; 6]

Administrative metadata is designed to help the management of resources over time. It can include data about who created a document, when it was created and the file type. Access rights and intellectual property rights are also part of the scope. Administrative metadata includes preservation metadata that defines how the resource is preserved over time. Preservation means tracking all changes to the resource metadata and creating the administrative metadata based on those changes. [5, p. 1-2]

Metadata standards define schemas for standardized cases of metadata usage. Standardization helps to utilize metadata in different platforms and programs because schema for same metadata is consistent. For example cameras save metadata properties such as camera type, time, lens type etc. These schema standards are made for certain focus groups that vary from imaging and geography to finance. Schemas can control how the data must be formulated or presented and what values are acceptable. Many standards use XML to present the syntax. Even though there are many standards not all structures are standardized. [3]

2.2 Taxonomy and controlled vocabularies

Taxonomy is a term that means the science of classifying animals and vegetation. Its use has broadened to describe hierarchical categorization. Other commonly used name for it is controlled vocabulary which has broader meaning and it is more descriptive of the use it has in digital context. Controlled vocabulary has a list of suitable values and the list is administrated by editor and not by the user. Some systems can enable users to add more terms to vocabulary but that is not part of normal procedure. Controlled vocabulary can have varying structures but the most important ones are term list and taxonomy. [5]

Term list is a list of terms in single level hierarchy. For example term list can be used for descriptive metadata for file format or language. All metadata fields that have controlled value groups and limited number of terms can be term lists. Below is a figure of a term list “Product Hierarchy” that is used to control site navigation links. Adding terms to the list is forbidden for normal user, but editor with sufficient rights can do the job. In SharePoint from where this picture is, term sets can be seen as term lists as they are both single level hierarchical structures. [7]

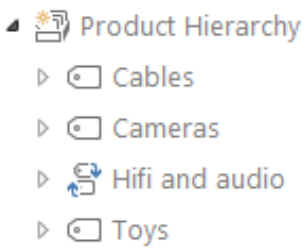

Figure 1. A term list.

Taxonomy differs from term lists in a way that it has deeper structures. It is easily understandable by having a tree-structure with parents and child-elements in multiple levels. Terms also have closer or further relationships to other terms depending on their position in the tree structure. The figure below shows taxonomy with simple structure and terms in different levels of the tree. [7]

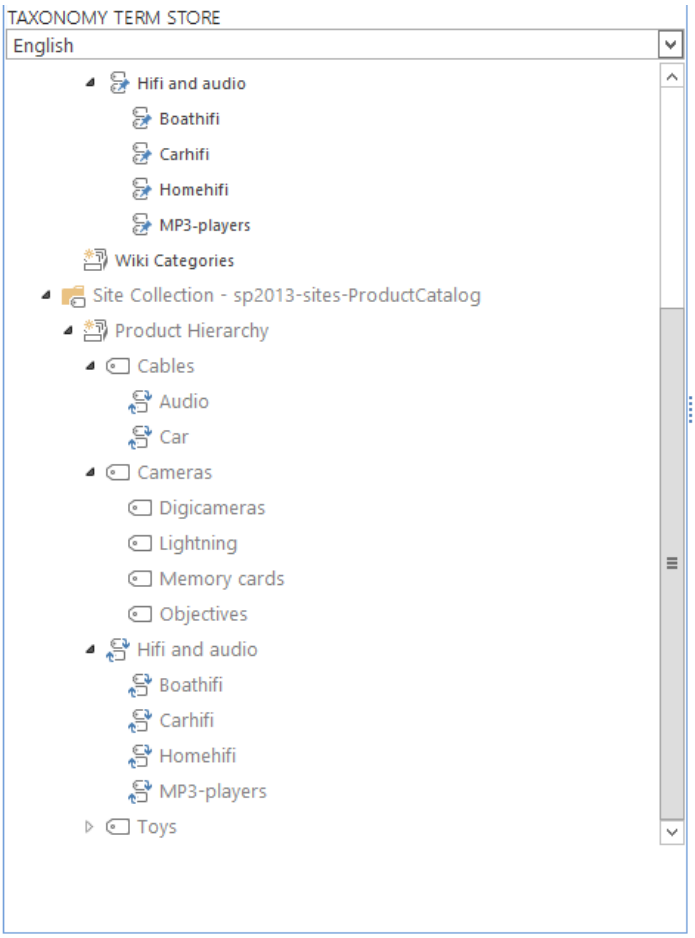

Figure 2. Controlled vocabulary with a four levels deep hierarchical structure.

When constructing metadata properties it is important to know value types for all needed metadata. Depending on the values that the metadata will receive in some cases it might be best to implement a controlled vocabulary or a term list. Content management systems often include administrative metadata that the system calculates or can figure when data is inserted into the system. For descriptive metadata some fields can be calculated by the system, for example document title from file name, but many properties must be given a value when they are brought into the system. These properties can hold values such as company unit and product category that are often most fluent to define with a controlled vocabulary.

The number of required metadata fields for any content type is a factor of administrative needs and policies. A large number of metadata fields can help in organizing and searching data, but too many descriptive metadata fields needing to be filled will make the data collection slow and tiresome. The system might require the data to be shown in certain way or link the data to other similar data. After recognizing all requirements for metadata properties, there are factors when deciding what metadata should have controlled vocabularies. Metadata values that are not managed inside the CMS are not convenient and too large controlled vocabularies are best broken into smaller entities. User selectable values with controlled value groups that are likely to be used multiple times are most likely best done with controlled vocabulary. Depending on the CMS the system might have built-in metadata fields like “last modified date” or “creator” which work better than making own controlled vocabulary. [8]

2.3 SharePoint metadata and administration

In SharePoint all fields for content types can be understood as metadata. Most metadata fields are understood as normal data fields. By definition a title-field is metadata property but because the value type is string, it is most often discussed being a string field. Metadata in this context means properties that are controlled vocabularies and all properties such as the previously mentioned title are site columns.

Managed metadata service application is a SharePoint service that enables the use of managed metadata in all different sites. This service creates a term store in database and enables the creation of managed terms. Managed terms are controlled vocabularies. Term store can be connected to multiple web applications enabling use of the same taxonomy in different environments. [9]

SharePoint includes multitude of libraries for pages and documents. All content are stored inside lists. [10]. Depending on the use they have default columns like title, created by, approved, rating etc. Some of these are not shown to the user who for example uploads documents to the document library. What is shown is dictated by the library view and excess information that would confuse more than help can be hidden from the views. Normally properties like version number, file size and current editor are not shown in list views. Metadata is not only limited to default site columns. SharePoint has managed

metadata service hosts metadata values and controlled vocabularies. Metadata site columns can have a controlled vocabulary to choose values from. [11]

Production environments can grow to hundred gigabytes in size with thousands of workspaces. Metadata is often added to content types like documents to help in sorting and searching. SharePoint 2013 has multiple new features that utilize metadata and search index to query for content. For example previous version did not have content search web parts or faceted navigation. [12]

3 Information findability

Information findability describes how easily data can be found from a web page. In web pages information findability methods consist of navigation and search. Both are important factors when user tries to find certain data from a web page. Some users are more prone to use either navigation or search when searching for data. [13, p. 525; 14, pp. 50-57]

The purpose of a navigation is to help the user to find what they are searching and to show the current location within the web site. The location within the web page in this situation also reveals what is in the current pages content. [14, p. 59]

Searching is divided into two areas in search engine technology. Web search engine defines a search engine that crawls World Wide Web. Enterprise search crawls content within enterprise. Enterprise is understood as intranet in many occasions. The term intranet is becoming outdated as very few enterprise environments restrict connections only to internal sources. Remote access and cloud hosted services such as Office 365 do not fit in the definition even though they are used for the same purposes. [10]

The function of a search application is to provide results from a target context with a given query. The search process starts with the query being parsed to different formats depending on the search engine. The parsed query then functions as instructions for the search engine. Query parsing varies and some engines include a query language that has operators which are factored when the query is being built. A query language can include functionalities such as filtering certain document types, ranking results by attributes or properties like metadata, combining words and selecting only exact matches. The search query engine then uses the index to collect all results and then ranks them depending how well they fit the query. [15; 16]

3.1 Enterprise search

There are dozens of different enterprise search vendors and products. Google has Google Search Appliance, Microsoft has Microsoft Search Server which is part of SharePoint Server. Enterprise search is the software that handles searching and provides search functionalities in the enterprise environment. This does not mean that the results

can not be provided to outside the enterprise, but that the information searched composes of data inside the enterprise boundaries. The enterprise can comprise multiple sources of content such as file systems, business data, custom content, network drives, external web sites etc. Enterprise search differs from web search engines such as Google web search. It has the ability to index multiple different repositories. Web search does not have as wide support to filter a query result group with faceted terms. Faceted search, navigation or browsing means viewing information from multiple perspectives by filtering the query result group with metadata. Web search collects very limited metadata compared to what enterprise search uses when indexing enterprise repositories and they rarely include faceted browsing. Enterprise search may also utilize access control to restrict access to the query results depending on the user permissions. [16; 17; 18]

Architecture in enterprise search can be divided into smaller pieces. As seen in figure 3 below, which visualizes SharePoint search, content consists of multiple sources that host the searched data. This is the data that will be available for the search results and ultimately restricts possible result group. The main search engine processes the content source data and creates search index. Content index is done by the index engine that crawls the content. Crawling data means loading all possible source files and processing them. Crawling requires the engine to have the ability to process the documents or the data in native format. In SharePoint search conversion is enabled by iFilters and every file format requires said filter if the file contents are to be indexed. While going through the content source, index engine creates a content index from texts and properties. After the index is complete, the query engine is able to execute queries to content index and return results for queries made to the search engine. The query engine and the index engine are dependent on configuration data to have information on crawl sources, configuration and crawled properties. Configuration data is also the only part of the enterprise search engine that can be made changes on. [16; 19]

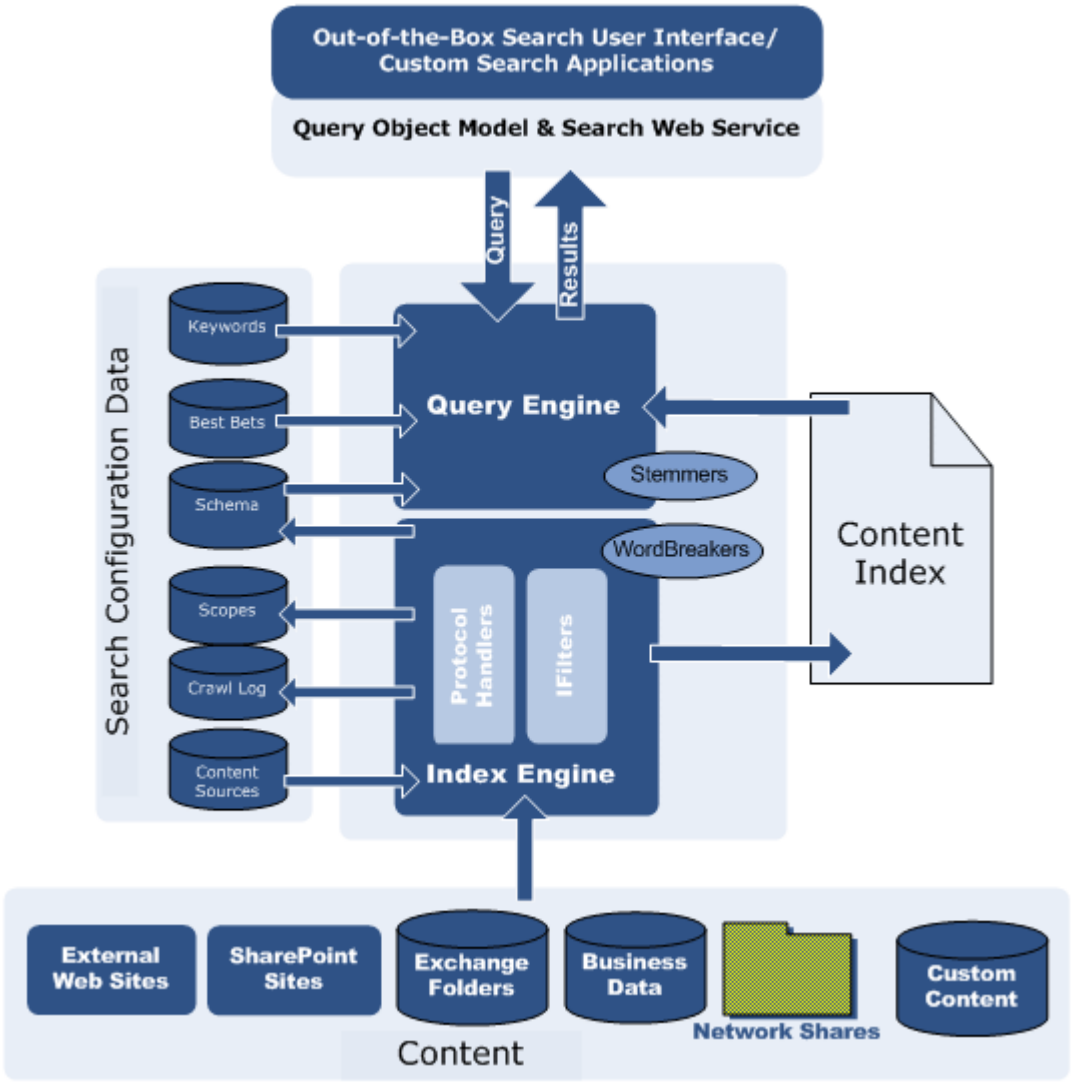

Figure 3. Enterprise Search architecture as presented in Microsoft Developer Network [16].

Enterprise search users are company workers that use search in work environment and software that utilize search application protocol interface. CMS like SharePoint have many applications built that benefit from search. It is also simple to build applications that utilize the search potential by using the search API. Effective search brings business benefits with reduced time looking for information, which results in more efficient work hours. In company environments where employees feel search to be ineffective and lacking bad availability has many drawbacks. Instead of using CMS employees might start using network drives or even external drives to save files and benefits from versioning and information sharing are lost [20]. Not being able to find information also raises discontent towards using common tools to store and use information and documents.

3.2 Search index and queries

Indexing and crawling content source means going through every item in the source that can be processed, and changing it to text, properties and metadata. These are then handed to index engine which creates index and property tables. In SharePoint this means that all documents have their properties in separate table with connection to text-index that holds the documents full text. Properties-table also holds all security information like user rights to every document. After this the properties and the texts are processed in a way that removes all noise words and breaks the texts into simple words. Default noise words for SharePoint 2010 search are: a, and, is, in, it, of, the and to. These are removed before creating index and they hold no weight in search results. Noise words can be easily modified to include or exclude words by changing the configuration file. Also FAST Search Server takes into account linguistic features such as synonyms, stemming and spell checking when breaking the text into words. [16; 21]

SharePoint search has two roles, query and index. Indexing is done against all defined content sources. They can be manually added and all created web applications are crawled by default. Crawling is done by a timer job and frequency may be altered depending on needs. For example solutions that depend on search to show data from content index will not show any changes to the data until the data has been crawled again. Crawling is done against all content and all crawled properties that are defined in the search schema are extracted during the crawl. Crawled properties can also be mapped to managed properties which makes it possible to target search to this group of properties. This group of managed properties can hold properties from multiple crawled properties or site columns as that is what they basically are. Managed properties include metadata like title, name and modified by. For example description could have four different site columns and by mapping those to same managed property a search query could be refined to target them all at the same time. The picture below shows multiple title-like crawled properties mapped to a single managed property. [13; 22]

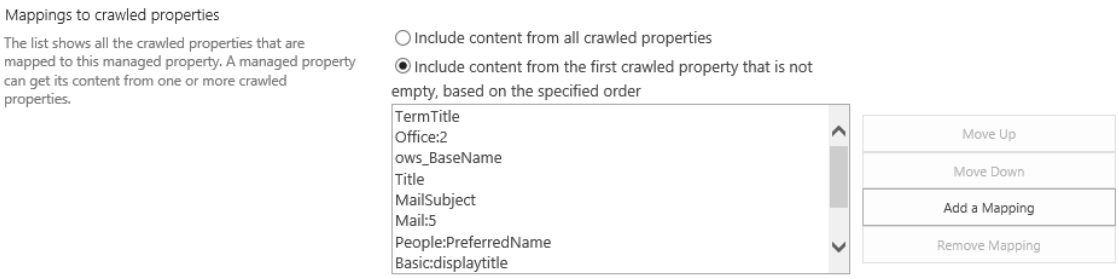

Figure 4. Property mappings of single managed property.

Making queries to SharePoint Search in this project is mostly done using the content search web part. By using managed properties and targeting the content search web part to query pictures, text or documents and using list templates and item templates it is possible to make the web part to write custom HTML with search query result data. This makes it possible to use search content index to not only search for results, but to compose content for pages using key words. This means that having a metadata property product number makes possible to get all product items with said metadata from multiple sources to one page with one query. [23]

3.3 Content query and content search in SharePoint

There are two ways to query content in SharePoint. One is to query it straight from the database and the other is to use search index and query it from there. In a web page this would mean that content queries would be done using content query web part and content queries through search index would be with content search web part. Both can achieve similar results but the basics are very different and both have advantages and disadvantages. The two main differences lie in result accuracy and performance. [24]

Content search web part styles are defined in HTML files. Changing the styles would require some knowledge in basics. Content query web part is displayed according to a XSL-file. Which is more difficult to modify depends on preferences, but on general level more developers have acquired sufficient skills to understand HTML than XSL-files. [24]

These two ways to get a group of results differ in the way what is returned. Content search is a query to search index and it means that results change only when the index

changes. This only happens when search service has crawled the content. As was previously mentioned, the content query web part executes the query straight against the live content and the results are instantaneously updated when content has changed. [24]

Result availability is different for both web parts and it comes from the search index. The index is built from crawled content and some site collections might not be indexed. Content query on the other hand can query any site collection. Content query can also account for document minor versioning and display them from the content. Search can only index the major versions and minor ones are excluded from the search index and thus are not shown in the queries. [24; 25]

Performance should be the sought after feature with the search based content queries. Query performed by using content query web part returns every column from the target list even if only few were required. This requires more data to be transferred form the database server to web front. This also means that non-specific queries, such as in figure 5, which ultimately target many lists can return large number of items and it will be heavy burden on the database server. Of course content queries can be optimized by targeting them and limiting number of results and returned columns, but the work can be challenging or even impossible in certain environments where, for example, data is scattered in multiple libraries through multiple site collections. SharePoint does not have relational database and that means that it is not fit for functions that require high transactional information. On the other hand content search query is executed against the search index and does not burden the database. [24; 26]

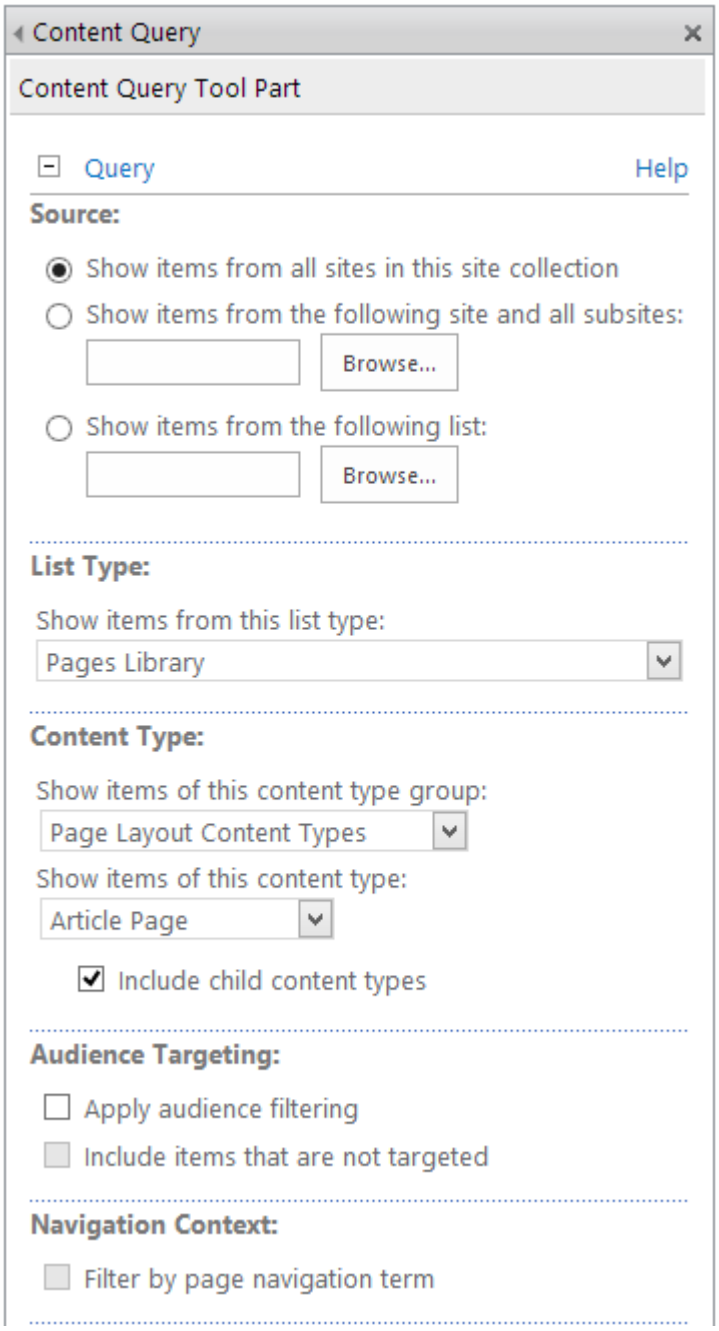

Figure 5. Content query web part can be set to target specific list or more broad scope. Large queries return more data and are heavier on the database server. Query on picture targets pages-list with content type filter.

Content queries return more specific data and are more up-to date with the content but they have heavier effect on page load times and server performance. Content search is easier to modify to suit page layout and scales better with the amount of content. It is not unusual to have a company intranet start page with over twenty content query web parts. They can be suboptimal with large scope such as in the query in above figure. This kind of amount results in many queries and will have effect on the page load time. Search

service that is responsible for the search index can also be configured to use separate server and scaled accordingly. This kind of model is more flexible in large environments. Content queries have a direct effect on other server functions such as loading pages and documents. Increasing performance would require upgrading more servers than just the one search service in run on. [26; 27]

4 SharePoint feature adequacy for ecommerce

4.1 Website requirements for online stores

An ecommerce website has requirements that it must fulfill to be successful. According to Chloë Thomas, (2012) website is one of three core foundations for electronic business, the other two being cash flow and products with product promotions. The main point of the website is to get products sold. Even with the best products, a bad website will fail and will not support the two other core foundations. Chloë mentions that a good ecommerce website has following functions: shows products, represents brand, supports marketing, good conversion rate, gathers customer information, gives customer service and fulfills all legal requirements. They are business aspects and in ecommerce implemented through user interface. Having nice usable interface enables conversion of website traffic to sales while simultaneously strengthens the brand. Previously mentioned legal requirements vary from country to country but generally include data protection, consumer protection and electronic commerce regulations. [28, p. 24]

Feature comparison in this thesis will be made against Amazon. Amazon has been around for nearly two decades and having such a longevity tells of strong brand and shows that it is doing things right by being able to grow and maintaining business. Amazon sales have grown every year and it is a mark of good conversion rate. Profits have not grown but getting products sold is the main concern and Amazon is doing it well. [29]

4.2 Comparison of most common ecommerce website features

Ecommerce sites have simple features that are easy to compare. Comparison concentrates on how Amazon implements features listed below. We will also look into whether it is possible to make similar features in SharePoint 2013. Styling with CSS can be done similarly to every environment and this comparison focuses on the raw possibility of similar features. Full list of compared features is given below:

- Product navigation.
- Shopping cart and checkout.
- Discounted, most popular products.

- Product filtering by properties.
- Product images.
- Site design.

4.3 Product navigation

Product navigation is the major factor that accounts the time it takes to buy products online. It was measured that variance in monthly sales changed by 61% based on how long it took to make the purchase. The process of arriving to a web page and then trying to navigate to what you are looking for varies depending on what products are being sold and the amount of products. As navigation is a hierarchical structure it expands in height, width or both as product categories increase. Navigation items in most ecommerce sites use a controlled vocabulary by product use. Steve Krug, (2006) says that browsing must give a sense of how things are organized. This means that the navigation and site structure must be built so that the user has a sense of location and can perceive what is behind navigation terms that are usually product categories. Krug also bundles search with navigation as frequently users jump straight to the site search rather than swim through the navigation hierarchy. [14, p. 50-57; 30]

The most common navigation presentation is to list product categories on the left side of the web site such as seen in figure 6. Amazon has one of the most extensive navigations from all ecommerce sites partly because their product catalog is huge. Amazon has a single list that acts as main product navigation and it lists all different departments. Product hierarchy is deep because of the sheer number of products and different product categories. With mouse-over navigation reveals sub-navigation that has refiners to selected navigation item. The popup-navigation also has a featured product advertisement. [31]

Figure 6. Online shop www.Amazon.com main department navigation.

Opening a department page, such as books in previous figure, changes the navigation context to include only department specific topics. Faceted browsing is also enabled after moving deeper in the site hierarchy.

Product navigation by a controlled vocabulary is possible in SharePoint. In publishing sites a navigation can be set to use a term set that is same controlled vocabulary that products use in connected product catalogs. Navigation controlled by a controlled vocabulary can be customized and easily changed to respond to changes in product base. When publishing portal is properly configured, all changes to product catalog automatically reflect in customer end. Navigation markup can be set to render div-elements and told to set identifiers for easier styling. Without customizations it is impossible to enable multiple navigations in one page that use different metadata navigations.

4.4 Shopping cart and checkout

Shopping cart and handling the end customer checkout comprises of the process of adding a product to the shopping cart, handling multiple items in the cart and a checkout process. Amazon has patented one-click buy where a user who has previously inputted payment details can buy products with a single click in the product page. More common way of shopping is to first add items to the cart and then checking out. SharePoint 2013 does not have any native solution for this process and the lack of it brings up the threshold to start an ecommerce site. Additionally there are not shopping cart apps sold in the Microsoft Office Store that would help with this problem.

One solution to get a shopping cart is to include Dynamics CRM. It is a software package sold by Microsoft and it has sales and product management functionalities for SharePoint. CRM introduces a shopping cart that uses AJAX and has service calls to handle adding, removing and checking out. Having other shopping carts at this time requires building your own custom or using a readily available solutions with .Net or JavaScript. For this project no shopping cart was introduced as integration with CRM was not done. Integration would bring more value by augmenting new features such as product management.

Building a custom shopping cart would require lot of work and customizations that go against the previously mentioned guidelines that SharePoint 2013 should be left as uncustomized as possible. [10]

4.5 Discounted and most popular products

Featured products are ones that are promoted or suggested by the system to the customer. By knowing what the user has purchased or by calculating products that connect to other meaningful products in some way, it is possible to refine a group of products to promote. Promoting the right products gives more chances for the customer to find the right products or to create an impulse buy and thus increasing conversion rate. The presence of promoted products does not only increase the sales of promoted product during the time it is visible, but also after the user has stopped viewing it. The promoted items can be connected to a category, a single item, a group of items or they can be selected

with some other cause. Amazon has many kinds of different promoted items. [32] For a single product part of them are:

- Frequently bought with the product.
- Customers who bought the product also bought.
- Customers who bought the product also bought from other categories.
- For individual product groups Amazon has but not limited to promotions for.
- Best sellers in category.
- Pre-order from category items.
- Recently released in category.
- Similar products in category.

Amazon also suggests products from the users input and behavior. Part of these promotions are:

- Products that were often bought with users shopping cart products.
- Recently viewed products.
- Products that were common with users previously bought products.
- Products that Amazon relate to my shopping trends based on previously bought.
- Other motives to promote products include but are not limited to.
- Discounted products.
- Editorial suggestions.
- Top new coming releases.

Product promotions are also important aspects in marketing plan and they must be done to be easily changed. According to Thomas (2012) promotions are also a part of the third core aspect of successful online business. [28]

SharePoint 2013 has out of the box features for promotions and selective query rules. All products are queried from the search index and search tracks some of the user interaction. For example search service can track what products are frequently viewed by the

same person with relation to other products. Using this it has the logic to offer related products. This feature can be provided with out-of-the-box web part. It is also possible to build logic on top of the product stack with query rules. For example promoting products with certain value like discount percentage it is possible to highlight discounted products as seen in figure 7 from SharePoint Conference 2012. Building as deep business logic for promotions as what Amazon has would be very hard. User interaction saved by search index is not as broad as would be needed in making as good refinements as what Amazon is using. [33]

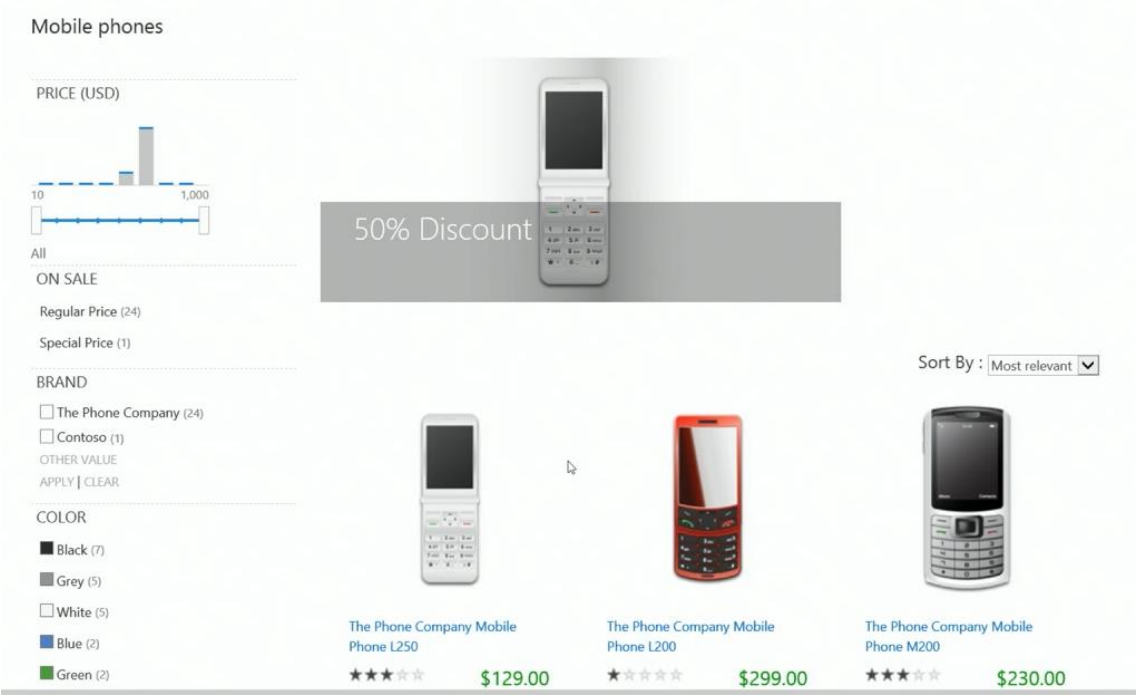

Figure 7. Product promotion by discount as presented in SharePoint Conference 2012.

Discounted product can be highlighted from other products returned with same search query. Promoted items are selected with logic built in publishing site.

4.6 Product filtering by properties

Products have metadata properties that are often used to filter result groups with user selectable values. Filtering like this is known as faceted navigation. Amazon enables faceted navigation in all pages below main page. Filters are defined by the metadata that products have in current page context. Part of the filters Amazon shows after user has searched for products are:

- User review rating.
- Filter by price range.
- Brand.
- Condition (new, used, refurbished).

SharePoint has a component to show similar filters for search results. Faceted navigation is defined to metadata terms in term store. Managed properties can be defined as filters for certain term, terms and its sub terms. This means that filtering with these properties is enabled for the selected navigation items. In the publishing portal these filters can be used in views where filtering from a group of products is made possible by all products having same metadata property to filter by. Figure 8 has filtering enabled by two metadata properties. In this project filtering with product properties was implemented for price and brand. Amazon also shows the number of products behind faceted navigation value, which is also included in SharePoint. Configuring faceted navigation was problematic for Price. It is of format currency, but faceted navigation understands it as string. This resulted in lots of unwanted digits with every filter value.

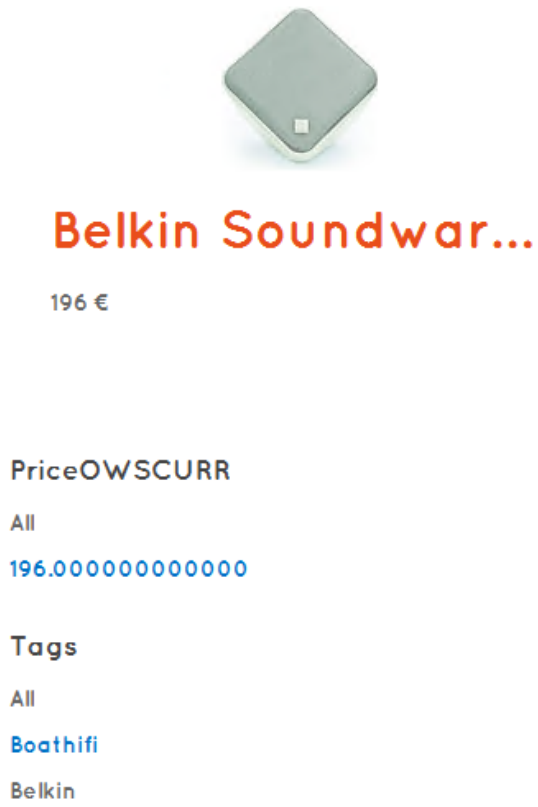

Figure 8. Faceted navigation with selected filter values return one product.

Above figure has two faceted navigation terms selected and result group is single product. If faceted navigation selections would be deselected then result group would be larger.

4.7 Product image carousel

Product pictures are shown in individual product page. This includes the tooltip picture that is shown in product listings. Amazon has common practice in this with image carousel where the user can select what to show in the larger box. Figure 9 has image carousel in left side and selected image is shown larger in the middle. In HTML markup all bigger pictures are on top of each other and only one is shown depending on the one selected. SharePoint application for this feature is very feasible. Having image library with added metadata for product number gives possibility to query all images from the single library or whole site to show the pictures in one content search web part. This web part can use the product number from generated product page URL to use in search query. Query also limits searched items to pictures. Display template is fully customizable HTML and

JavaScript. There is one ready-made control template for image carouse, but creating Amazon-like fluid visualization requires custom HTML. Tooltip picture for the product comes from the product item as it has column for picture file. The out of the box carousel for multiple pictures in SharePoint didn't work very well. Pictures were not showing and the carousel picture selector was displaying more pictures than what was actually included.

Figure 9. Amazon product page with tooltip image selector on left side.

Above figure shows Amazon product details. Image carousel and product details are all shown in the same form.

4.8 Site design

Site design is mainly styling issue that does not concern this project, but the ability to style efficiently is of great interest. Amazon uses responsive layout and designing such site sets restrictions on how the page must be built. SharePoint having master pages to define how the outline of a pages looks has been very stiff to modifications. In this project a simple HTML page from Digital Illustrated internet site was converted to a working master page. Site looked and functioned like the simple HTML page. Methods such as master page converter enables working from design page to master page very efficient. Master page done in this work did break default styles and creating master pages properly would require that style definitions for the HTML page are done while taking SharePoint styles into consideration. Using common libraries like Bootstrap that reset all styles are one of the problems that must be resolved before outside libraries can be used.

Modifying a page design requires work in many files. Master page is the outermost element. Page is rendered inside a master page content placeholder. Pages can be static welcome pages, category page or product pages. Inside pages are web parts. In search-driven site web parts have control templates and item templates. Lightweight changes to design can be achieved through themes. Though they are convenient way to change fonts, colors and background images they do little to display templates or the layout of the site. [34]

5 Ecommerce proof of concept for Digital Illustrated

5.1 Project scope and high level architecture

The proof of concept was done for Digital Illustrated Inc. It creates ICT solutions with Microsoft technologies. The company had no previous experience with SharePoint 2013 ecommerce projects nor search-driven content. The focus areas for the project were ecommerce features and the use of content search web parts.

The development environment was installed on premises and was built in one Microsoft computer virtualization software image. The platform was SharePoint 2013 RT on top of Windows Server 2012. SQL Server 2012 was also in the same virtual machine with Visual Studio 2012 and SharePoint Designer 2010. Code editing was done in Designer. Later in the project SharePoint Designer 2010 was changed to 2013-version as Microsoft released a new version and 2010 couldn't be used anymore. The virtual computer image where project environment was installed in was transferred between multiple computers during the project, but development was done in only one computer after it became evident that the development environment was very heavy compared to previous versions of the application platform and resulted in performance loss. The bottleneck was computer memory. It was possible to develop with eight gigabytes of installed memory, but with six gigabytes the SharePoint search service would hang. The search service is very important aspect in the project architecture and so development was done with a computer roughly double the performance than what is used to develop applications for the 2010-version.

Ecommerce-solution was created inside a one SharePoint web application with multiple site collections. All site collections were made with out-of-the-box-templates. Catalog template was used for storing the product data and publishing portal was used for creating the front end for the ecommerce user interface pages. Project done during the thesis doesn't utilize any of the localization features and English was the only language.

The goal for the project was to evaluate how SharePoint ecommerce search-driven implementation fulfils requirements driven from modern ecommerce solutions and to create a proof of concept for a functioning ecommerce solution. Previous versions of application

platform have not been very flexible to bend to ecommerce requirements. This is problematic because large customizations to SharePoint 2013 applications are not recommended by Microsoft [10]. It is also common knowledge that customizations in this product family environments are very time consuming.

Product management is done in a product catalog site collection. Data is stored in libraries that accept product content type and product properties are administrated through SharePoint list views.

Project site structure is divided into two parts, the product catalog site collection and the publishing portal site collection. This also divides interaction for users, since administrators maintain product details in catalog and customers look at the ecommerce site through publishing portal. Both site collections have their own out-of-the-box template. Ecommerce customer user interface is based on publishing portal template and all product details are stored in site collections made with product catalog template. The product catalog site collection has lists that have all product information. As seen in figure 10, architectural model supports multiple catalog site collections and catalog lists. Whole product base is combination of every product stored in these lists. Managed metadata is used to generate the navigation on publishing portal and with the same metadata all product categories and individual product pages are created dynamically with their respective templates. All information from product catalog is transferred through search index to publishing portal. Excluded from the 9 are product pictures. They are stored in a list in product catalog site collection.

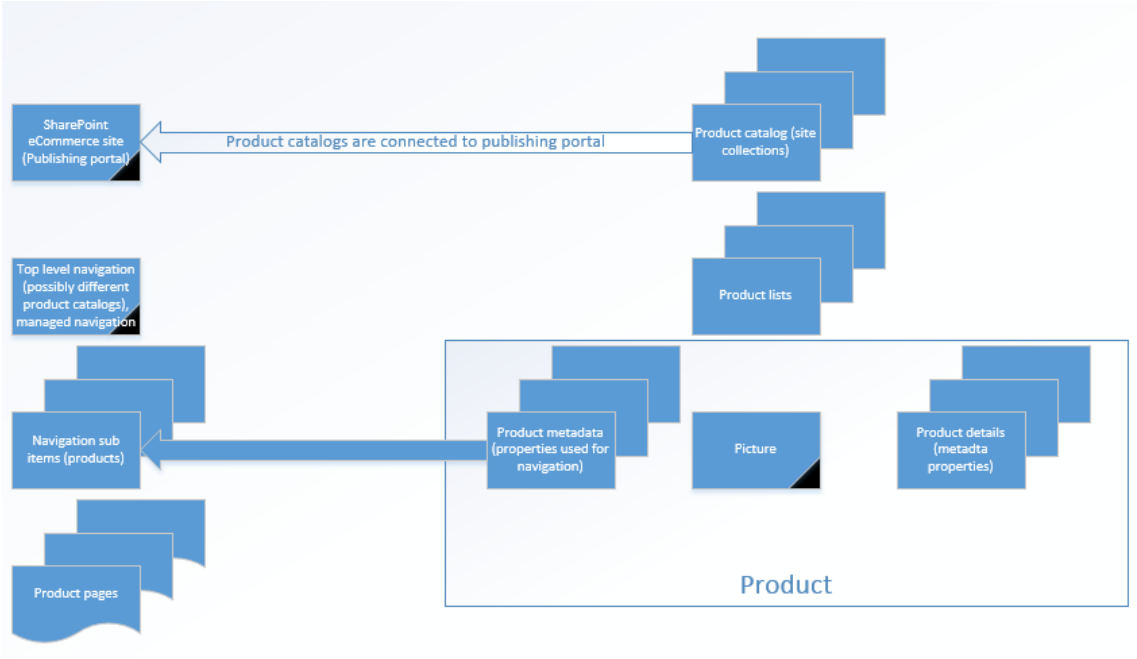

Figure 10. Site architecture.

Above figure explains how publishing portal and product catalog are connected. Information is stored in product catalog and everything in publishing portal is built on top of this information. Metadata rules the navigation and how pages are shown

Architecture for individual product page is shown in figure 11. Navigation metadata is used to query product content and then shown with multitude of content search driven web parts.

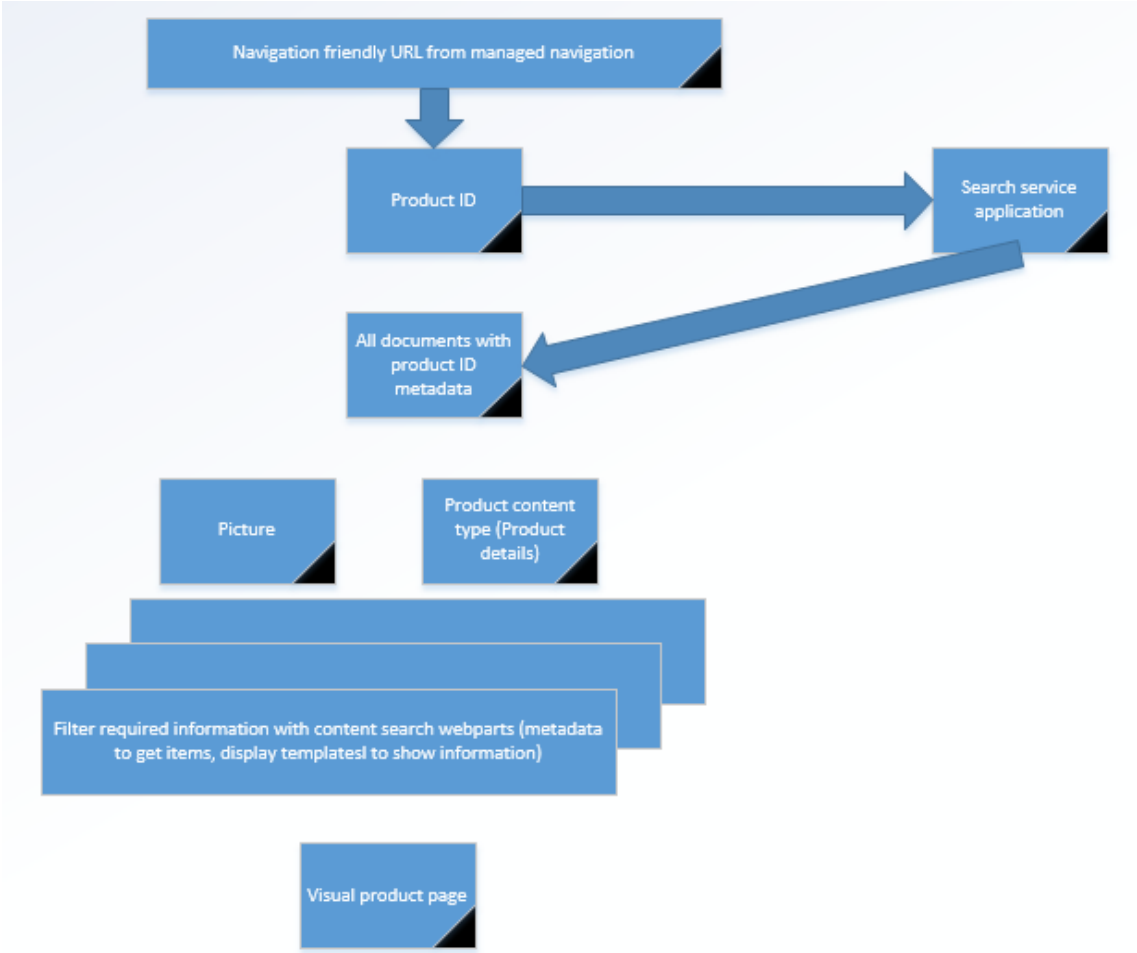

Figure 11. Product page information architecture.

Figure 11 has information flow for single product page. Product data is constructed from product number that is stored in the navigation and used to submit a query to search service. Data is brought with various search based web parts.

5.2 SharePoint information model

Architectural model for the project is set by product catalog. All product details are stored in a product catalog and content types and site columns with attached metadata are also there. SharePoint search service indexes all information in said catalogs and makes it possible to use the same information in places outside the catalog site collection as shown in figure 12. Limits can be set to restrict certain libraries or library items to not show in search queries.

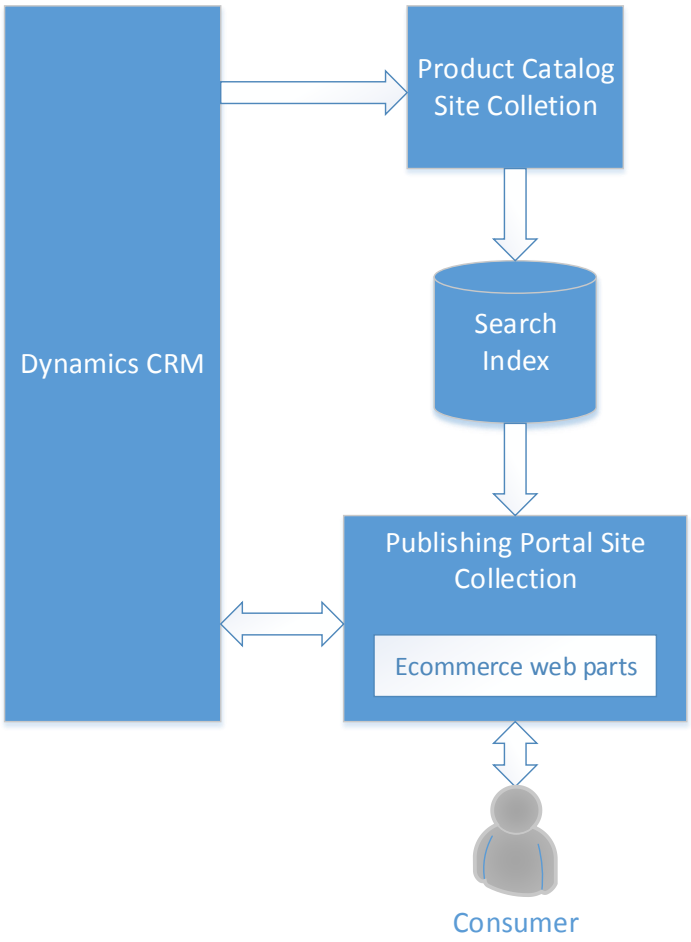

Figure 12. Ecommerce solution components with Dynamics and SharePoint 2013 [35].

Unlike shown in figure 12, Dynamics CRM was not integrated with SharePoint in this project. CRM offers varying beneficial resources to handle products more fluidly. It also offers shopping cart functions and cashing. While CRM holds all product information for commerce purposes all that is required to process end user transactions must also exist in SharePoint. Product pictures are one that might only exist outside CRM. Individual product is processed as content type. This content type has properties like title, price, picture, technical details, product number etc. For this project all properties were selected so that information that must be shown to the end user, and all information that is needed for commerce were available. Most properties were selected by what some of the common ecommerce sites use. Concerning the architecture the most important is product number as it identifies and singularizes a product. Identifier is used to query search service for information and for example every picture in the product pictures library could be singled out to individual products by matching the identifier. Product properties are listed in figure 13. [35]

Columns

Name	Type	Status
Title	Single line of text	Required
Item Number	Single line of text	Optional
Rollup Image	Publishing Image	Optional
Product category	Managed Metadata	Required
Price	Currency	Optional
Technical info	Multiple lines of text	Optional
Product description	Multiple lines of text	Optional

Figure 13. Product content type site columns.

A product catalog library can support products with multiple content types if needed. In this project only one product type was used in every product catalog library. Product type means one content type which consists of site columns that identify a product. These columns are listed in figure 13. Multiple libraries were used to simulate situation where end users, who handle product details, are only working with part of the whole product supply. To create functioning navigation, a metadata structure was created in SharePoint managed metadata service term store. This controlled vocabulary divides all products into categories based on their function. Site template was configured to use metadata navigation and it is using this metadata controlled vocabulary to define its values. This metadata acts as navigation hierarchy in the publishing portal and the metadata values are visible to the customer in navigation when searching for products. Metadata values are also shown in the publishing portal URL. Publishing portal is using a so called user user-friendly URL. This means that addresses could be for example of format “http://sp2013/sites/PublishingSite/Metadata-Term-Set/Metadata-Term” and not complex like “http://sp2013/sites/PublishingSite/Site-Name/Default.aspx”. When using user-friendly URL, it is easy to use web parts that query content by the parameters in navigation. For example extracting metadata parameter from previously mentioned URL would be done using query text “{URLToken.1}” in content search web part.

5.3 Defining sufficient content types for search

In a situation where product details are updated constantly and customer data is shown from search index, it is essential to know how long it takes for updates to product data to appear in user end. SharePoint product content type consists of site columns such as title, price, product category etc. All product properties that want to be used for searching

must be crawled and bound to managed properties is search service. Product number site column was added to product pictures library. Normally SharePoint search service doesn't index by this site column, but for the implementation we had to be able to query all pictures for single product. Product number site column also added as crawled property in the enterprise search service. Then the field was mapped property in search service, so queries done to search service could be done with this mapped property. As seen in figure 14 all product related definitions are done in product catalog.

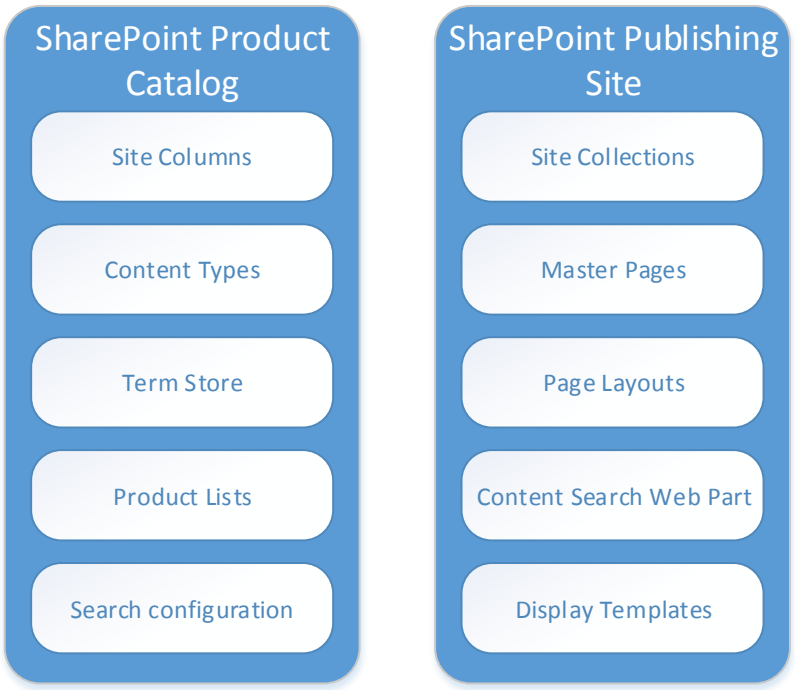

Figure 14. Project architectural entity mapping. Product catalog has data structures and publishing site interface related resources. [35]

The default product with image content type was expanded with new site columns and named Article. After that it was added to product catalog library as shown in figure 14. Expanding default content type meant including metadata fields for product category and brand, adding text fields for technical and product descriptions and currency property price. It is possible to add multiple content types to product catalog library but it was evaluated unnecessary in this limited scope where single product definition with as simple as possible properties was the most efficient to work with.

By defining the product catalog content type properly, creating metadata structure for navigation and fill-in choices for metadata property brand we had all required information to build publishing site to function as the ecommerce site. All libraries with product data

were published, making connection to publishing portal possible. While making the catalog connection possible we defined what metadata term set would be used to group all the individual products in individual product catalog libraries. This term set also functions as the site navigation in publishing portal, and navigation terms are used to form relative URL. Figure 15 shows two catalog connections where both are libraries from same product catalog site collection. Terms act as refiners to all the products that the publishing portal has. This means that product queries are filtered with terms parsed from URL. It is also possible to use the URL terms in other search driven web parts such as the content search web part.

Figure 15. Catalogs connected to publishing site.

Product catalog does not limit the web application where publishing site must be located. Catalogs can be published outside current web application to other applications. In this project both publishing site and product catalog were located inside one web application as individual site collections. Catalogs connected in figure 15 were in another site collection than the publishing portal. All site collections are listed in figure 16. Only two were used in the project.

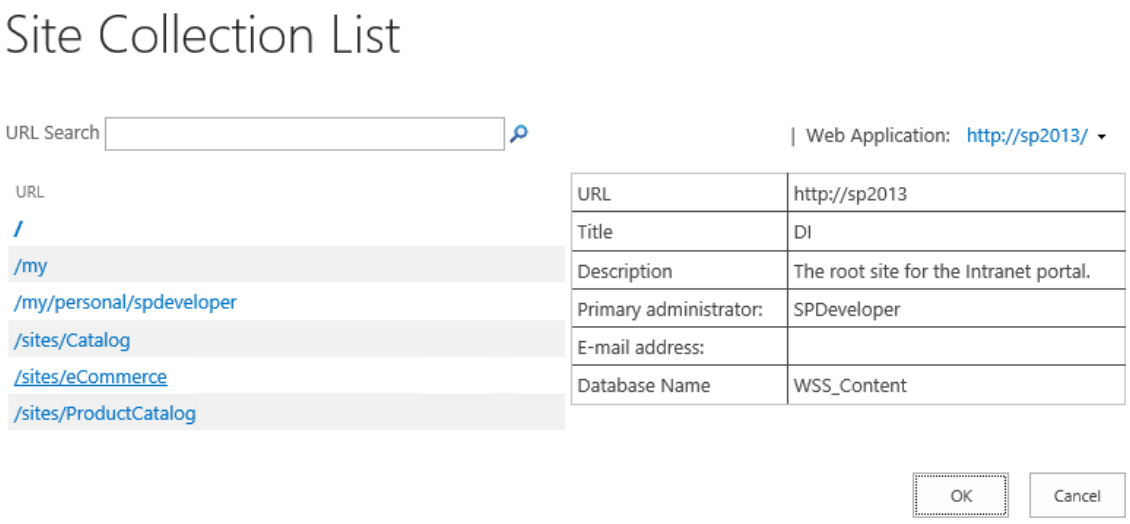

Figure 16. Multiple site collections in one web application.

Figure 16 shows all site collections inside one web application. Relative URL defines where they can be found in relation to the web application base URL.

5.4 Creating user interface components for publishing portal

The publishing site was created using SharePoint publishing portal site template. It includes most suitable features from the out of the box site templates. Publishing portal can make connection to all published product catalog libraries and include the metadata navigation these libraries incorporate to replace or add to its own navigation. Connecting to product catalog also by default creates the category page layouts and item page layouts. These layouts are content pages that have search driven web parts to generate content. Layouts and templates are HTML files that have SharePoint markup inside HTML comment tags “<!—“and “->” as seen in figure 17. This makes it easy for web designer with some basic knowledge of SharePoint development to hands on work with the technology. Files are also modified straight on the server making creation and modifications to the master page, the page layouts and the display templates very swift. [36]

```
<div>
    <!--CS: Start Page Field: Catalog-Item URL Snippet-->
    <!--SPM:<%@Register Tagprefix="PageFieldCatalogSourceFieldControl" Namespace="Microso
    <!--MS:<PageFieldCatalogSourceFieldControl:CatalogSourceFieldControl FieldName="75772
        <!--PS: Start of READ-ONLY PREVIEW (do not modify)--><div align="left" class="ms-
    <!--ME:</PageFieldCatalogSourceFieldControl:CatalogSourceFieldControl>-->
    <!--CE: End Page Field: Catalog-Item URL Snippet-->
</div>
<div style="">
    <!--CS: Start Web Part Zone Snippet-->
    <!--SPM:<%@Register Tagprefix="WebPartPages" Namespace="Microsoft.SharePoint.WebPartP
    <!--SPM:<%@Register Tagprefix="cc1"  Namespace="Microsoft.Office.Server.Search.WebCon
    <!--MS:<WebPartPages:WebPartZone runat="server" Title="&#60;%$Resources:cms,WebPartZo
        <!--MS:<ZoneTemplate>-->
            <!--CS: [AuthorOWSUSER] Start Catalog-Item Reuse Snippet-->
            <!--DC:To render the search property using a rendering template, change the "
            <!--SPM:<cc1:CatalogItemReuseWebPart runat="server" UseServerSideRenderFormat
            <!--SPM:<RenderFormat>-->
            <!--DC:Renders value from search without any additional formatting.-->
            <!--SPM:</RenderFormat>-->
            <!--SPM:</cc1:CatalogItemReuseWebPart>-->
        <!--ME:</ZoneTemplate>-->
    <!--ME:</WebPartPages:WebPartZone>-->
    <!--CE:End Catalog-Item Reuse Snippet-->
</div>
```

Figure 17. Markup in catalog layout that includes two snippets.

Executed code is found inside the comment tags. Figure 17 has both HTML and Share-Point specific code. Figure 18 shows custom HTML master page with start of body-tag where ribbon snippet is included. Ribbon is important snippet and it is required in every master page.

```
'xml><![endif]-->
  </head>
  <body>
      <!--CS: Start Ribbon Snippet-->
      <!--SPM:<%@Register Tagprefix="SharePoint" Namespace="Microsoft.
      <!--SPM:<%@Register Tagprefix="wssucw" TagName="Welcome" Src="~/
      <!--MS:<SharePoint:SPSecurityTrimmedControl runat="server" HideF
          <div id="TurnOnAccessibility" style="display:none" class="s4
              <a id="linkTurnOnAcc" href="#" class="ms-accessible ms-a
                  <!--MS:<SharePoint:EncodedLiteral runat="server" text
                  <!--ME:</SharePoint:EncodedLiteral>-->
              </a>
          </div>
          <div id="TurnOffAccessibility" style="display:none" class="s
              <a id="linkTurnOffAcc" href="#" class="ms-accessible ms-
                  <!--MS:<SharePoint:EncodedLiteral runat="server" text
                  <!--ME:</SharePoint:EncodedLiteral>-->
              </a>
          </div>
      <!--ME:</SharePoint:SPSecurityTrimmedControl>-->
      <div id="ms-designer-ribbon">
          <!--SID:02 {Ribbon}-->
          <!--PS: Start of READ-ONLY PREVIEW (do not modify) --><div c
      </div>
      <!--MS:<SharePoint:SPSecurityTrimmedControl runat="server" Auther
          <!--MS:<wssucw:Welcome runat="server" EnableViewState="false"
          <!--ME:</wssucw:Welcome>-->
      <!--ME:</SharePoint:SPSecurityTrimmedControl>-->
      <!--CE: End Ribbon Snippet-->
      <div id="s4-workspace">
          <div id="s4-bodyContainer">
```

Figure 18. Master page includes ribbon snippet by default after conversion.

I had Digital Illustrated internet site raw HTML file, picture files, cascading style sheet files and JavaScript files. After copying these to sites “_catalogs/masterpage”-folder, the master page converter was used to generate a simple master page file with just the necessary snippets for it to work. Snippets are SharePoint user controls that must be included for normal features such as page editing or navigation. They include important and vital controls like ribbon, web part zones, site and global navigation. Converting has some limits, for example multiple HTML forms-tags are not supported and those had to be removed from the web page source code before conversion could successfully complete. Conversion automatically adds snippets for ribbon and main web part zone. Search and other web part zones plus navigation had to be added to master page to make it work properly. Figure 18 shows the resulting master page file after the conversion. Process to make master pages from simple HTML files is fast and the resulting file

is easy to modify. Snippet styles after conversion were totally broken as the source HTML had styles that overwrote default SharePoint styles in snippet elements. Because of overwritten styles navigation completely missed the normal dropdown functionality default in normal global navigations. Navigation was shown as in figure 19. Successfully converting master page required only minor changes to DI internet site source code. Most user interface problems after the conversion were because of Bootstrap style resets.

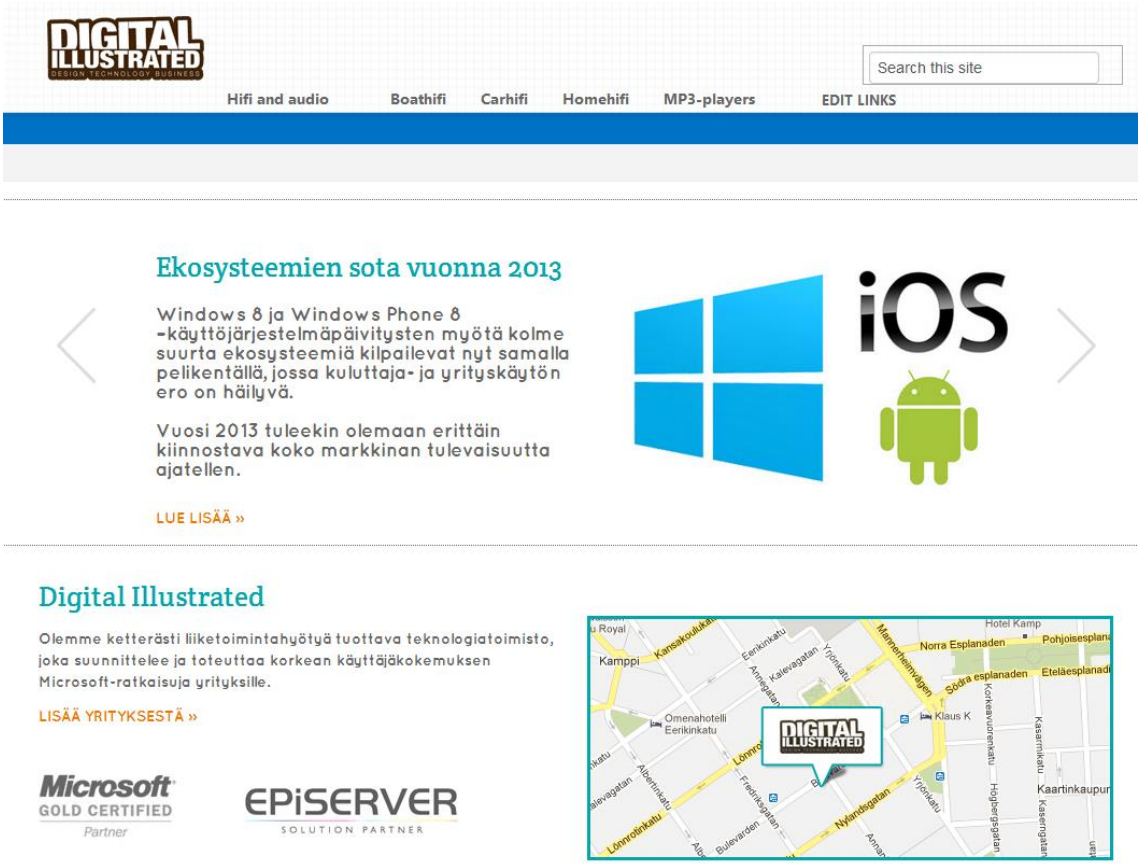

Figure 19. Static master page after conversion and adding navigation and search.

When catalog is connected properly and navigation is set to follow a metadata term set, selecting top-level terms from global navigation auto generates URL and opens category page with search query results. The category page automatically queries all products from product catalog with selected metadata navigation term. For example this page could be “Hifi and audio”-page that functions as entry page for all products in that category. All contents in this page are shown in master page main web part zone. Automatically generated category pages were used in this project because all required web parts were added in page edit mode and not straight to page by editing source files.

A single product page template is named as catalog item template. In product pages search service returns query result done with product number and product properties are passed to “catalog item reuse”-web part. By default page shows all available properties from product item, including title, price, description etc. This template had to be edited to hide unnecessary information and add simple styling as all unwanted properties were also printed on page inside simple HTML div-elements. Styling and placeholder texts were added to highlight title, mark price and add currency marker. By default the product image saved in product catalog library doesn’t show on the page. Images in the project were fetched with separate content search web part.

5.5 Lifting content from search index with web parts

Search service configuration controls what properties can be used to query content. By default most common file formats like office documents and PDF-files are indexed and their formatted text content can be found in search index. In this project all content that are queried from the search index are items from product libraries and pictures. As all items have attached metadata it is possible to single out individual products and product groups from search index.

All information must be queried through the search service. Catalog pages and product pages do it automatically after activating catalog connection, but some common ecommerce features must have custom queries and display templates. For example lifting all pictures from product catalog with single query requires custom item template in content search web part. Picture content type had product identifier metadata included which made it possible to query images related to single product.

Showing information from given search query is done using display templates. Display templates are only used in web parts that are search driven. They control what item properties are shown and how they are rendered in the web part. Content search web part requires two kinds of display templates to render content. Whole control has its own control template and then every single item has an item template. Controls template defines how query results are shown in relation to each other. Item templates define how individual results are shown. As seen in figure 20 the number of query results and templates that are used are defined in the web part settings. Also properties that are passed to the templates can be modified and defined in the web part. These properties are the

metadata that each search query result has such as Title, PublishingImage, PictureURL and Path. [37]

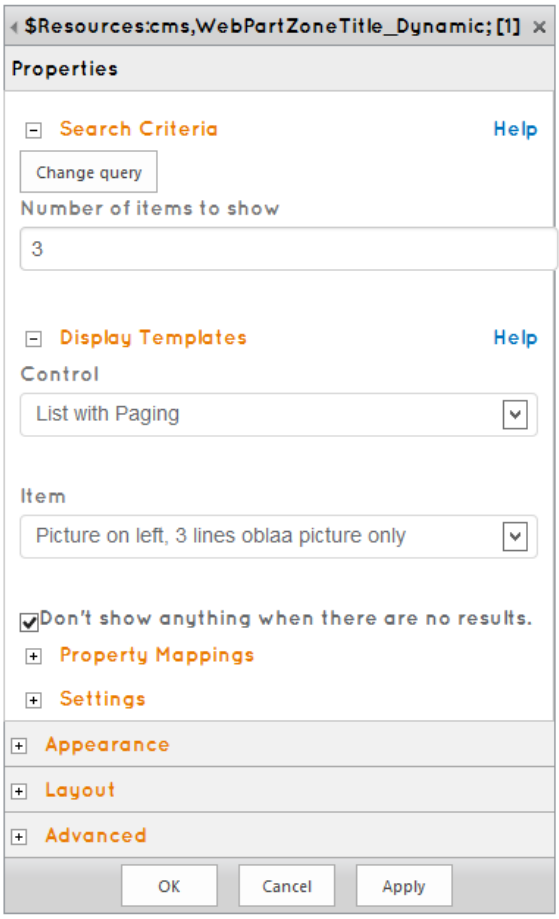

Figure 20. Web part settings with display template choices.

Display templates consist of HTML and JavaScript file. In figure 20 these are “List with Paging” and “Picture on left, 3 lines oblaa picture only”. To get a picture carousel for product page it required a new display template. The used control template was existing, but the item template was new. The new template was created copying existing template HTML file in Master Page Gallery and then renaming it. SharePoint handles the JavaScript file creation itself and there were no changes that would require modifications to it. The Item display template was changed so that it would show the picture but have no links or other rendered properties. After modifying the template the search query with images was able to show images properly. Control template was not changed to render a carousel from the images but it would be possible just as in any other web site.

After properly configuring the content search web part and setting the display templates, the search query shown in figure 21 needed to be configured. By using proper display templates the query results are shown as simple pictures as was seen in figure 8.

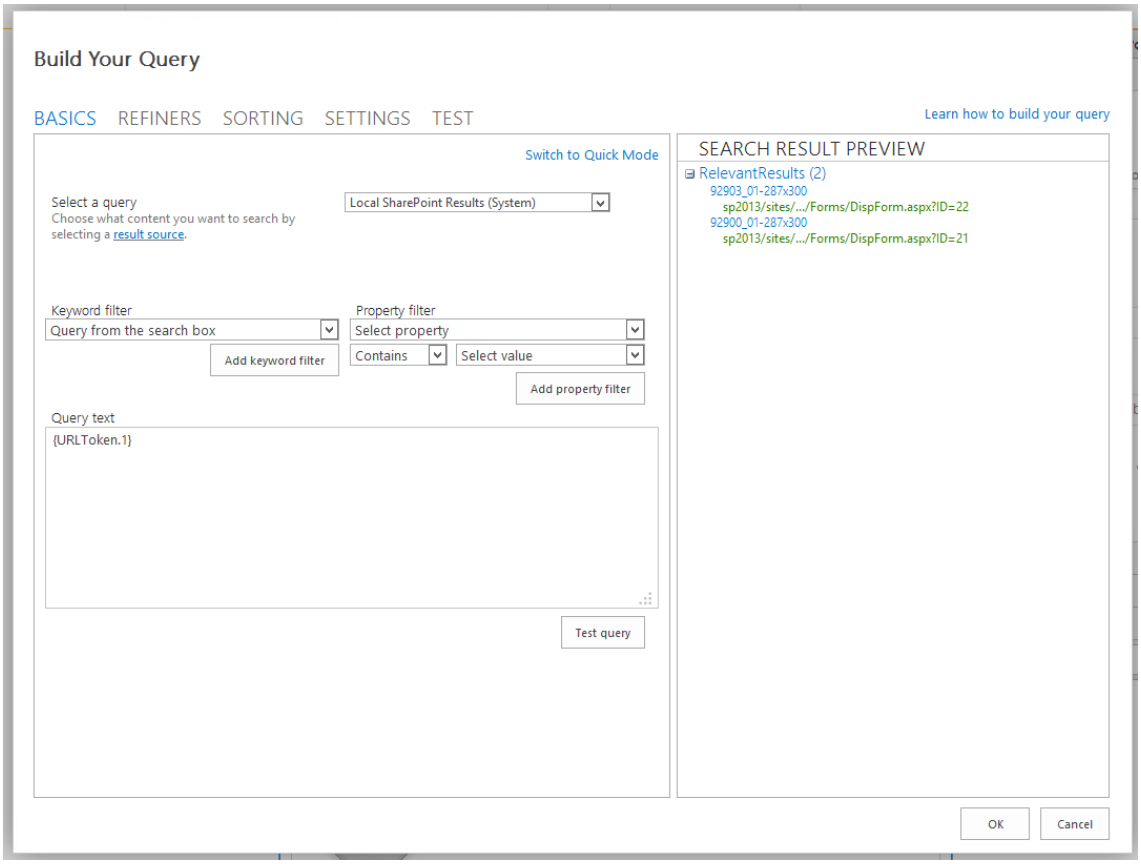

Figure 21. Content search web part query builder with query that uses first URL term.

As seen in figure 21 the images were searched from the SharePoint site search index with first URL token. This token is set to be product number on product pages. Refiners for the same query were set to filter away all other content types than images. Without the refiner the query would also return product content types rather than just the wanted images. Two results on the search result preview window are from the indexed content of product catalog.

6 Conclusion

The proof of concept done during the thesis gave insight about SharePoint 2013 features, especially content search. In search-driven model content is queried from search index using content search web parts. The publishing portal navigation can be set to use the same controlled vocabulary that is used to categorize products. Metadata is also in important role when a search result group must be categorized or filtered. Controlled vocabularies were created in the term store and used to categorize search results and to manage navigation. Search enables a faster way of querying content straight from index instead of slower queries straight to content.

Product catalog site collection was used to store all product details for the proof of concept. Metadata model for product was built in catalog site. Getting it working was easy and required only minor changes to content types and enabling catalog connections. Metadata was easy to create but required manual work. Product catalog proved to be an effective site template for storing information and possible integration with other systems is intriguing.

Challenges that sprouted during the project were results from search service and publishing portal. Connecting publishing portals with product catalog is straightforward and supports multiple connections with multiple catalogs. Basic master page, layout and display template modifications were easily, but adding snippets to master page required work. Making clear product displays and image carousel with web parts required modifications to display templates.

Search-driven data utilization is a new thing in the new version. Benefits should be that querying should be faster than doing straight queries to content database. Pages also loaded before the queried content appeared on the page which makes the browsing experience more fluid. Though this model should be faster and require less from the platform, it would have been essential to execute some test if search service driven model is more high-performance than the same with plain content queries.

SharePoint 2013 has some of the common ecommerce features such as navigation by metadata and faceted navigation. Site navigation can be configured to use controlled vocabulary and multiple navigations with different controlled vocabularies would make it

on par with existing ecommerce site navigations. Lack of a shopping cart is major drawback and making one would require custom code or integration with for example Dynamics CRM. Search service does not have adequate information to make personalized product promotions. At the moment making a proper ecommerce application with SharePoint is hard. Best use of this application platform would be in online shops with small product base. It is easier to make one that has fewer products as navigation is by only one controlled vocabulary. Also in development environment the search service application required a lot of memory.

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